UNIVERSITI TEKNOLOGI MARA

MECHANICS OF TOTAL HIP REPLACEMENT (THR): THE EFFECT OF INCLINATION AND ANTEVERSION ANGLE ON THE PERFORMANCE OF EPOXY-UHMWPE ACETABULAR CUP

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 29 March 2017 to conduct the final examination of Muhammad Faris Abd Manap on his Master of Science thesis entitled "Mechanics of Total Hip Replacement (THR): The Effect of Inclination and Anteversion Angle on the Performance of Epoxy-UHMWPE Acetabular Cup" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Total Hip Replacement (THR) is a surgical procedures to replace the bone defects with prosthetic implant. Safe zone orientation and the materials of acetabular components are important criteria in THR as it may improve the performance of the implant. The objectives of this thesis are to propose the optimum safe zone orientation for Metal-on-Polymer (MoP) of THR, to study mechanical analysis based on the safe zone orientation and to suggest a composite material replacement for the acetabular cup. The methodology used comprised of three steps namely a numerical analysis in order to find the range of safe zone orientation with different femoral head diameter; a simulation study using finite element analysis (FEA) to attain the relationship between different size of acetabular components with the corresponding safe zone orientation angle acquired from numerical analysis; and to propose the experimental work of a new composite material to find the relevant data and feed the data for mechanical failure analysis in FEA. The results indicated that femoral head with diameter higher than 28mm exhibits greater safe zone orientation. The mechanical analysis of 36mm femoral head diameter using 5% Epoxy-Ultra High Molecular Weight Polyethyelene (EpUHMWPE5) at the corresponding safe zone orientation showed a reduction of 5.0388MPa, 4.5042MPa and 0.018344mm in terms of contact pressure (MPa), Von-Mises stress (MPa) and total deformation (mm), respectively. The new composite EpUHMWPE5 filler shows the highest Young's modulus compared to other variants. In conclusion, every size of femoral head diameter has its own unique safe zone orientation and the mechanical analysis using FEA shows that EpUHMWPE5 has improved the acetabular components performance compared to existing UHMWPE at 36mm femoral head diameter with its corresponding safe zone orientation.

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